

What is claimed is:

- 1 1. A method for estimating a remaining lifetime of a part in a piece of semiconductor
2 fabrication equipment, comprising the steps of:
 - 3 selecting a plurality of factors relevant to the remaining lifetime of the part, the plurality
4 of factors including a number of semiconductor wafers that have been processed by the piece of
5 semiconductor fabrication equipment since the part was installed in the piece of equipment; and
6 estimating the remaining lifetime of the part by a fuzzy inference.
- 1 2. The method of claim 1, wherein the plurality of factors include a length of time that the
2 part has been used.
- 1 3. The method of claim 2, further comprising replacing the part when the estimated
2 remaining lifetime falls below a threshold value.
- 1 4. The method of claim 2, wherein the fuzzy inference is based on the following fuzzy rule
2 set, in which P is the number of semiconductor wafers that have been processed by the piece of
3 semiconductor fabrication equipment since the part was installed in the piece of equipment, T is
4 the length of time that the part has been used, and L is the remaining lifetime of the part:
 - 5 if P is small, and T is small, then L is large;
 - 6 if P is medium, and T is small, then L is medium;
 - 7 if P is large, and T is small, then L is small;
 - 8 if P is small, and T is medium, then L is large;
 - 9 if P is medium, and T is medium, then L is medium;
 - 10 if P is large, and T is medium, then L is small;
 - 11 if P is small, and T is large, then L is medium;
 - 12 if P is medium, and T is large, then L is medium; and
 - 13 if P is large, and T is large, then L is small.
- 1 5. The method of claim 2, wherein the fuzzy inference is based on a fuzzy rule set
2 determined using empirical experience.

1 6. The method of claim 2, further comprising the step of automatically collecting the
2 following data for the part: the number of semiconductor wafers that have been processed by the
3 piece of semiconductor fabrication equipment since the part was installed in the piece of
4 equipment, and the length of time that the part has been used.

1 7. The method of claim 1, wherein:
2 the plurality of factors include a length of time that the part has been used;
3 wherein the fuzzy inference is based on the following fuzzy rule set determined using
4 empirical experience, in which P is the number of semiconductor wafers that have been
5 processed by the piece of semiconductor fabrication equipment since the part was installed in the
6 piece of equipment, T is the length of time that the part has been used, and L is the remaining
7 lifetime of the part:
8 if P is small, and T is small, then L is large;
9 if P is medium, and T is small, then L is medium;
10 if P is large, and T is small, then L is small;
11 if P is small, and T is medium, then L is large;
12 if P is medium, and T is medium, then L is medium;
13 if P is large, and T is medium, then L is small;
14 if P is small, and T is large, then L is medium;
15 if P is medium, and T is large, then L is medium; and
16 if P is large, and T is large, then L is small.

1 8. A system for estimating a remaining lifetime of a part in a piece of semiconductor
2 fabrication equipment, comprising:
3 means for automatically collecting and storing data representing the number of
4 semiconductor wafers that have been processed by the piece of semiconductor fabrication
5 equipment since the part was installed in the piece of equipment;
6 fuzzy inference means for determining degrees of fulfillment of a plurality of rules based
7 on a plurality of factors relevant to the remaining lifetime of the part, the plurality of factors

8 including a number of semiconductor wafers that have been processed by the piece of
9 semiconductor fabrication equipment since the part was installed in the piece of equipment; and
10 a defuzzifier for estimating the remaining lifetime of the part based on the degrees of
11 fulfillment of the plurality of rules.

1 9. The system of claim 8, wherein the plurality of factors include a length of time that the
2 part has been used.

1 10. The system of claim 9, wherein the rules include the following fuzzy rule set, in which P
2 is the number of semiconductor wafers that have been processed by the piece of semiconductor
3 fabrication equipment since the part was installed in the piece of equipment, T is the length of
4 time that the part has been used, and L is the remaining lifetime of the part:

5 if P is small, and T is small, then L is large;
6 if P is medium, and T is small, then L is medium;
7 if P is large, and T is small, then L is small;
8 if P is small, and T is medium, then L is large;
9 if P is medium, and T is medium, then L is medium;
10 if P is large, and T is medium, then L is small;
11 if P is small, and T is large, then L is medium;
12 if P is medium, and T is large, then L is medium; and
13 if P is large, and T is large, then L is small.